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ABSTRACT

This is one of a series of monographs developed by teachers in middle and high schools near Leeds, England. This volume presents a glossary of mathematical terms, in alphabetical order, each with a brief definition. Six appendices contain additional terms (cross-referenced in the main list) grouped by topics. The topics are: numbers, quadrilaterals, sets, symmetry, transformations, and units. (MNS)

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NOTES FOR TEACHERS OF MATHEMATICS

VOL. 1
GLOSSARY

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MATHEMATICS CURRICULUM STUDY GROUP
THE JOHN TAYLOR TEACHERS' CENTRE

VOLUME 1 - GLOSSARY

EDITION NO 1 MARCH 1977

This is one of a series of monographs edited by the Mathematics Curriculum Study Group. It was developed from work by teachers in Middle Schools and High Schools in the West Leeds area, particularly by

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A/G/25
77.03.23

MATHEMATICS CURRICULUM STUDY GROUP

(LEEDS WEST AREA)

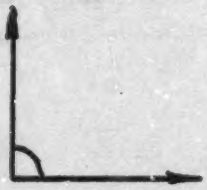
GLOSSARY

Acute angle See Angle .

Acute-angled triangle See Triangle .

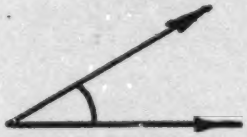
Angle A measure of the difference between the directions of two straight lines meeting at a point.
Common types of angle are:

(i) a right angle



comprising a quarter-turn or 90°

(ii) an acute angle



less than 90°

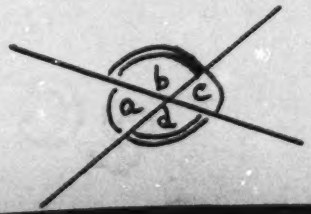
(iii) an obtuse angle

between 90° and 180°

(iv) a reflex angle

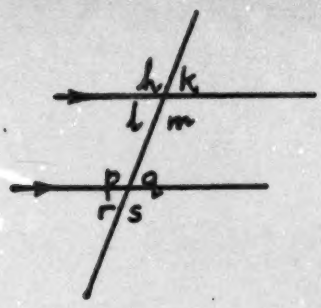
between 180° and 360°

Other frequently mentioned types of angles are:



vertically opposite angles

e.g. a and c, or
b and d.



A straight line crossing <u>two parallel lines</u> gives rise to (i) <u>corresponding angles</u>, e.g. h and p, l and r, k and q, m and s. (h can fit into p's place exactly if slid down the sloping line) (ii) <u>alternate angles</u> (angles on a 'zig-zag') e.g. l and q, or p and m.

<u>Arc</u> See Circle, parts of .

<u>Area</u> The measurement of the "surface covered" by a certain region, expressed in units of square measurement.

<u>Arithmetic mean</u> See Averages .

<u>Associative Law of Addition</u> The grouping of three numbers does not affect their sum: $(a + b) + c = a + (b + c)$.

<u>Associative Law of Multiplication</u> The grouping of three numbers does not affect their product: $(a \times b) \times c = a \times (b \times c)$

<u>Averages</u> Measures of central tendency used principally in Statistics. They comprise:

(i) the <u>arithmetic mean</u>: sum of the observations divided by the number of observations. (This value is often called 'the average' or 'the 'mean').

(ii) the <u>median</u>: the middle value of a set of observations when they are arranged in order of size.

(iii) the <u>mode</u>: the member of a set of observations which occurs most frequently.

<u>Axis</u> A number line drawn on a lattice or graph to indicate distances from the origin.

<u>Bar chart</u> Pictorial representation of data using rectangular columns of equal width.

<u>Base</u> The basic number linking a system of numeration, which tells us how many units of one kind are needed to form a new unit.

<u>Binary system</u> Counting in base two. This is the basic system used in automatic switching systems and computers.

<u>Bisector</u> A line which divides an angle, or another line, into two equal portions .

<u>Braces</u> See Appendix 3 , SETS .

Capacity The amount of space enclosed by a container. The litre is a unit of capacity for fluid measurement. (See Appendix 6, UNITS.)

Cardinal Number The number of a set. It answers the question "How many?".

Circle An infinite set of points in a plane all of which are at the same fixed distance from a given centre point.

Circle, parts of

(i) **Arc** Two different radii of a circle partition the circle into two arcs, called the major and minor arcs. (See Fig. 1.)

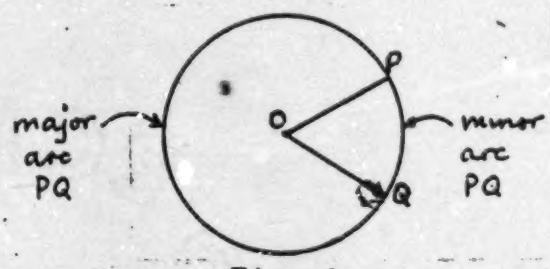


Fig. 1

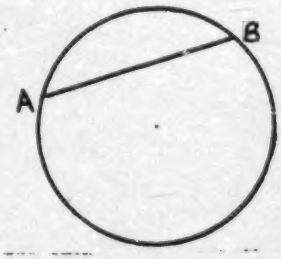


Fig. 2

(ii) **Area** 'Area of circle' means 'area of disc'.

(iii) **Chord** The line segment joining any two points on a circle, e.g. AB in Fig. 2.

(iv) **Circumference** The perimeter of the circle.

(v) **Diameter** Any chord passing through the centre of the circle.

(vi) **Disc** The set of points including the circle and all points within the circle.

(vii) **Radius** The line segment joining any point on the circle to the centre, e.g. OP, or OQ, in Fig. 1.

(viii) **Sector** In Fig. 1, the two radii OP, OQ partition the disc into two sectors, major and minor.

(ix) **Segment** In Fig. 2, the chord AB partitions the circle into 2 segments, major and minor.

Clinometer An instrument for measuring angles of elevation.

Common denominator Fractions $\frac{a}{b}$ and $\frac{c}{b}$ have a common denominator, b.

Common factor A number which is a factor of several numbers; e.g. the numbers 12, 18 and 48 have 2 as a common factor (or 3, or 6).

Common multiple A number which is a multiple of several numbers, e.g. common multiples of the numbers 2, 3, and 5 include 30, 60, 90 etc..

Commutative property

(a) for **addition** The order of adding two numbers does not affect their sum; $a + b = b + a$.

(b) for **multiplication** The order of multiplying two numbers does not affect their product; $a \times b = b \times a$.

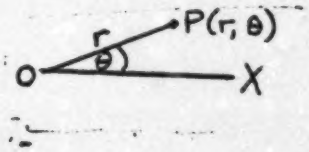
Complementary angle If two angles, a° and b° , are such that $a + b = 90$, then a is the complement of be (and vice-versa).

Composite number A number with whole number factors other than itself and 1; e.g. 8 has the factors 1, 2, 4, 8.

Cone A pyramid on a circular base.

Conic Sections A well-marked family of curves, obtained by the intersections of a plane with a cone (single or double), comprising: circle, pair of intersecting straight lines, parabola, ellipse and hyperbola.

Co-ordinates



In a plane, an **ordered pair** (q.v.) of numbers which fixes any point. The co-ordinates may be **cartesian**, i.e. of the form (x,y), giving the distance from two fixed lines, called axes, usually perpendicular, or **polar**, i.e. of the form (r, θ), giving a distance from a fixed point at an angle to a fixed line. (In 3-dimensional space, an ordered triple is required.)

Correspondence See Mapping.

Corresponding angle See Angle.

Counting numbers See Appendix 1, NUMBERS.

Cube number A member of this sequence: 1, 8, 27, 64, ... which can be written as 1^3 , 2^3 , 3^3 , 4^3 , ...

Cuboid A prism on a rectangular base.

Cylinder A prism on a circular base.

Denary (or decimal) System The customary system of counting on base ten.

Difference (of two numbers) The result of subtracting the smaller number from the larger.

Directed Number A number possessing either a positive sign or a negative sign, e.g. $^+3$ (read as 'positive 3'), or $^-2$ ('negative 2'). Such numbers are often represented by points on a number line.

Digit Any one of the ten symbols used in the decimal system of numeration.

Division The operation which is the inverse of multiplication so that

$$\frac{12}{4} = 3 \quad \text{(or } 12 \div 4 = 3\text{)}$$

is equivalent to $4 \times 3 = 12$
or $3 \times 4 = 12$

N.B. The number 0 has no inverse under multiplication, so that division by 0 is not defined.

Element See Appendix 3, SETS.

Empty set See Appendix 3, SETS.

Enlargement (or Dilatation) See Appendix 4, TRANSFORMATIONS.

Equation A mathematical sentence involving the use of the equality symbol = , e.g. $x + 3 = 7$.

Equilateral triangle See Triangle.

Equivalent fractions Two fractions, $\frac{a}{b}$ and $\frac{c}{d}$ are equivalent if

$$a \times d = b \times c \ .$$

Even numbers See Appendix 1, NUMBERS.

Factor One of the components that make up a coposite number in multiplication e.g. in $4 \times 3 = 12$, 4 and 3 are factors.

Flow chart A method of depicting a logical sequence of events, by a series of boxes.

Function See Mapping.

Greater than See Inequalities.

Hexagon A six-sided polygon.

Heptagon A seven-sided polygon.

Index A number used in a short-hand representation of the product of several equal factors; e.g.

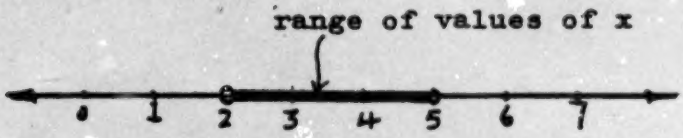
$a \times a \times a \times a \times a$ can be written a^5 ('a to the power of 5') ;

here the index of the power of a is 5.

Inequalities Mathematical statements using the signs $>$ and $<$ to indicate order of size, where the sharp end points to the smaller number e.g. $5 > 4$ can be read (left to right) as '5 is greater than 4' or (right to left) as '4 is less than 5'.

Inequalities (contd.)

The 'verb' $<$, or $>$, can be used successively as in $2 < x < 5$, to mean 'x lies between 2 and 5'.



The combined symbol $\leq$ means 'less than or equal to', and $\geq$ means 'more than or equal to'.

Intersection See Appendix 3, SETS.

Inverse element In addition, $^{-}3$ is the inverse of 3 (because $^{-}3 + 3 = 0$); in multiplication, $\frac{1}{3}$ is the inverse of 3 (because $\frac{1}{3} \times 3 = 1$).

Inverse operation Addition and subtraction are inverse operations; so are multiplication and division.

Isosceles triangle See Triangle.

Kite See Appendix 2, QUADRILATERALS.

Less than See Inequalities.

Line An infinite set of points in a single direction, usually symbolized with arrows at each end.

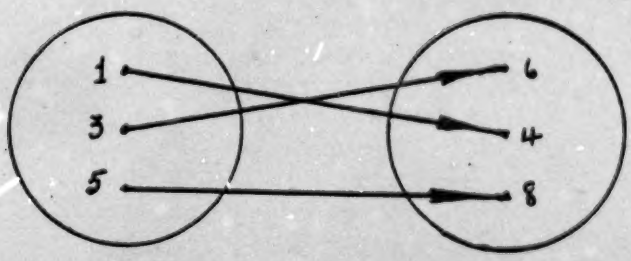
Line segment A section of line bounded by two end points.

Line symmetry A shape has line symmetry if it is unchanged by reflection in a mirror line, called the line of symmetry.

Lowest term fractions A fraction is reduced to its lowest terms or simplest from, when the numerator and the denominator have no common factors other than 1.

Mapping A relation between two sets in which every member of the first set is assigned to one or more members of the second set.

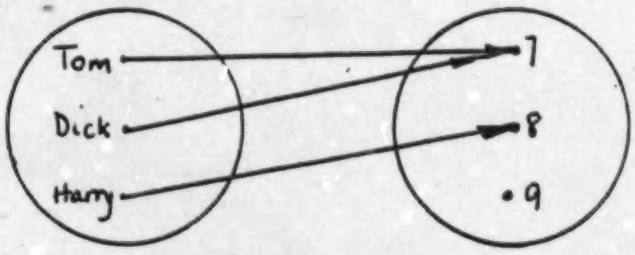
e.g.
(i)



one-to-one mapping (or one-to-one correspondence)

$x \longrightarrow x + 3$

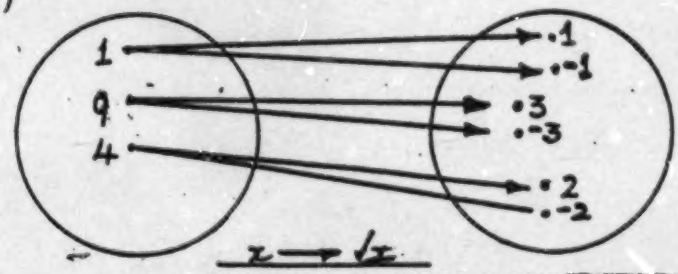
(ii)



'is aged'

many-to-one mapping

(iii)



$x \rightarrow \sqrt{x}$

one-to-many mapping

A function is a many-to-one, or a one-to-one mapping.

(Only examples (i) and (ii) above are functions).

(N.B. The definition of mapping varies slightly from text to text.)

Median See Averages.

Member See Appendix 3, SETS.

Mixed number The sum of a natural number and a fraction less than 1.

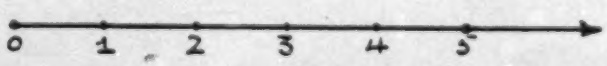
Mode See Averages.

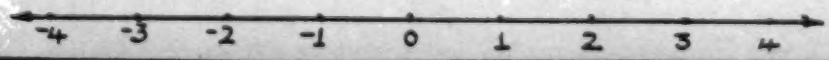
Multiple A whole number is a multiple of each of its factors; e.g. 14 is a multiple of 2, of 7, and of 14. 0 is a multiple of every number.

Natural numbers See Appendix 1, NUMBERS.

Net The plane geometrical shape obtained by opening out and flattening the faces of a solid shape.

Number line A pictorial representation, usually of whole numbers or integers, shown equally spaced on a line.

e.g. 

or 

Obtuse angle See Angle.

Obtuse-angled triangle See Triangle.

Octagon An eight-sided polygon.

Odd number See Appendix 1, NUMBERS.

One-to-one correspondence See Mapping, Example (i).

Operation Well-known examples of operations are: additon, subtraction multiplication, division, squaring, extracting square root, union and intersection.

Ordered pair A pair of numbers in which the order matters, so that for example, (2,4) and (4,2) are different pairs.

Parallel lines Two, or more lines, in a plane which never meet.

Parallelogram See Appendix 2, QUADRILATERALS.

Pentagon A five-sided polygon.

Percentage A fraction which is equivalent to $\frac{\square}{100}$ is called per cent, written as $\square$ %.

Perimeter The distance round any plane figure.

Perpendicular Two lines are said to be perpendicular if they meet each other at right angles.

Pi (π) Greek letter representing the value which is obtained by dividing the circumference of any circle by its diameter (and from certain other relations).

Pictogram (pictograph) A pictorial representation of data, by which numbers of objects can be easily compared.

Pie chart Pictorial representation of data using sectors of a disc.

Place value The value of a symbol in a number system, dependent on its position. Digits, bases and power are involved in analyzing the structure of place value, e.g. in a decimal (denary) system

$$34 = (3 \times 10) + 4$$
$$43 = (4 \times 10) = 3$$

In base eight, $34 = (3 \times 8) + 4$

Plane shape A shape having the property of possessing two dimensions, e.g. square, triangle, circle, et al.

Polygon A many-sided plane shape.

Prime factors Those factors of a given number which are prime numbers e.g. since $30 = 2 \times 3 \times 5$, 2, 3 and 5 are the prime factors of 30.

Prism A solid shape possessing a uniform cross-section; e.g. a Toblerone packet is a triangular prism.

Probability The likelihood of an event occurring, expressed as a fraction.

Product The number obtained by combining two or more numbers by multiplication.

Quadrilateral See Appendix 2, QUADRILATERAL

Quotient The number of times one number is contained in another.

Radius See Circle, parts of.

Rational Number See Appendix 1, NUMBERS.

Rectangle See Appendix 2, QUADRILATERALS.

Rectangle number A number which can be represented by a rectangular array of dots.

Recurring decimal A number in decimals form which contains a finite block of digits which is repeated infinitely.

e.g. $0.\dot{3} = 0.33333333333 \ldots\ldots$

$0.\dot{2}\dot{6} = 0.2626262626 \ldots\ldots$

$0.15\dot{4}2\dot{9} = 0.15429429429429 \ldots\ldots\ldots$

Reflection See Appendix 5, TRANSFORMATIONS.

Reflex angle See Angle.

Regular polygon A polygon with all its sides equal, and all its angles equal. The two simplest examples are the equilateral triangle and the square.

Rhombus See Appendix 2, QUADRILATERALS.

Right angle See Angle.

Right-angled triangle See Triangle.

Rotation See Appendix 5, TRANSFORMATIONS.

Rotational Symmetry When a plane shape fits its outline more than once per revolution when rotated about a point, it possesses rotational symmetry, (see also Appendix 4, SYMMETRY).

Scalene triangle See Triangle.

Sector See Circle, parts of.

Segment Se Circle, parts of.

Sequence A set of numbers written down in such a way that the next number can always be predicted.

e.g. 1, 3, 5, 7, 9, 11 .... (the sequence of odd numbers)
1, 2, 4, 8, 16 .... (the sequence of powers of 2)
1, 1, 2, 3, 5, 8, 13, 21 ... (the Fibonacci sequence)

Set See Appendix 3, SETS.

Significant figures Used in 'rounding-off' any given number to a required degree of accuracy: e.g. 32 564 is expressed to 5 SF, but would be 32 600 to 3 SF.

Similar figures If, by some enlargement, one figure can be made to coincide exactly with another, then the two figures are similar.

S.I. Units See Appendix 6, UNITS.

Square See Appendix 2, QUADRILATERALS.

Square number A member of this sequence: 1, 4, 9, 16, 25 .....
which can be written as 1 , 2 , 3 , 4 , 5 .....

Statistics The branch of mathematics dealing with the collection, presentation and interpretation of data. (A particular item of data may be referred to as a statistic.)

Subset See Appendix 3, SETS.

Sum The result of the addition of two or more numbers.

Symmetry See Appendix 4.

Tally Marks A method of recording a number of similar occurrences,
e.g. 𝍸 𝍸 III = 13.

Tessellation A tiling pattern.

Tonne A unit of mass equal to 1000 kilograms.

Transformations See Appendix 5.

Translation See Appendix 5, TRANSFORMATIONS.

Trapezium See Appendix 2, QUADRILATERALS.

Triangle A three-sided polygon.

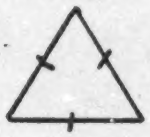
Triangles may be classified according to (a) the relative length of their sides:

e.g.

scalene - no two sides equal.

isosceles - two (at least) sides

Triangle (contd.)

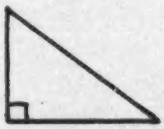


equilateral - all three sides equal.

(alternative definitions exist in terms of symmetry).

or (b) the nature of the largest angle

e.g.

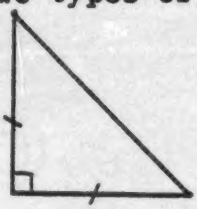


right-angled

acute-angled

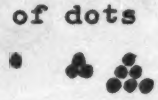
obtuse-angled

These two types of description may be mingled, e.g.



- **isosceles right-angled**

Triangle number A number which can be represented by a triangle of dots



1, 3, 6 are the first three triangle numbers.

Union See Appendix 3, SETS.

Universal set See Appendix 3, SETS.

Venn diagram See Appendix 3, SETS.

Vertex (plural: vertices) The meeting point of lines or edges which form a plane or solid shape.

Volume The measurement of the 'space occupied' by a certain solid shape, expressed in units of cubic measurement.

Whole number See Appendix 1, NUMBERS.

APPENDIX 1 - NUMBERS

Several well-defined sets of numbers exist:

1. The counting, or natural, numbers viz. $\{1, 2, 3, 4, 5, \ldots.\}$
2. The whole numbers, viz. $\{0, 1. 2, 3, 4, 5, \ldots\ldots.\}$
3. The integers, viz. $\{\ldots -4, -3, -2, -1, 0, 1, 2, 3, 4, \ldots..\}$
4. The rational numbers, i.e. the set of all numbers which can be expressed as $\frac{a}{b}$, where a and b are any integers, except that b cannot be zero (see note under Division). When expressed in decimal form, a rational number always terminates or recurs.
5. The irrational numbers i.e. the set of all numbers which can not be expressed as $\frac{a}{b}$, where a is an integer and b a non-zero integer.

   Examples are: the square roots of 2, 3, 5, 6, etc., π, and e, the base of Naperian logarithms.
6. The even numbers i.e. the set of all integer multiples of 2. All other integers are odd.

(See also Sequence.)

APPENDIX 2 - QUADRILATERALS

Quadrilaterals A quadrilateral is a plane figure bounded by four straight sides.

(Two definitions are given for most of the following quadrilaterals; the first is of a traditional nature, the second based on symmetry.)

Kite: A kite is a quadrilateral with two pairs of adjacent sides equal.
Or: It is a quadrilateral with one axis of symmetry, which passes through opposite vertices.

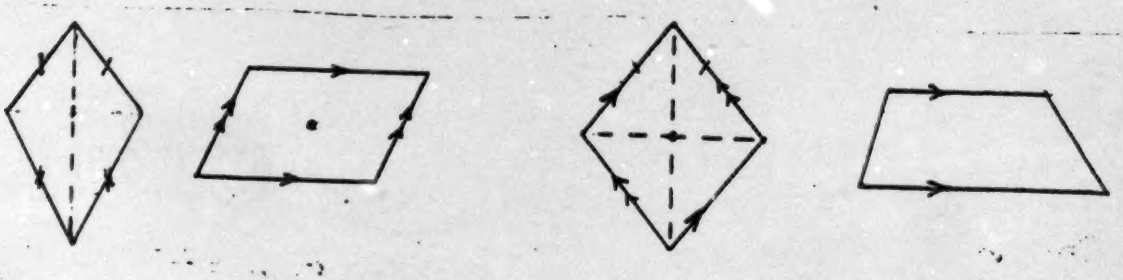
Parallelogram: A parallelogram is a quadrilateral with opposite sides parallel.
Or: It is a quadrilateral with rotational symmetry.

Rectangle: A rectangle is a parallelogram with one angle a right angle.
Or: It is a quadrilateral with two axes of symmetry which pass through the mid points of opposite sides.

Rhombus: A rhombus is a parallelogram with one pair of adjacent sides equal.
Or: It is a quadrilateral with two axes of symmetry which pass through opposite vertices.

Square: A square is a rectangle with one pair of adjacent sides equal.
Or: It is a quadrilateral with four axes of symmetry.

Trapezium: A trapezium is a quadrilateral with one pair of opposite sides parallel.



kite parallelogram rhombus trapezium

APPENDIX 3 - SETS

A SET is a collection of definite and distinguishable objects; e.g. all the children in the class who have brothers form a set, all the prime numbers form a set.

Terms and symbols used in discussion of sets include:

Braces 'Curly brackets' or 'set marks' $\{.....\}$

e.g. $\{a, o, e, u, i\}$ is read as

'the set of letters a, o, e, u, i, ' or, alternatively 'the set of vowels in the English alphabet'

This example illustrates the fact that order is immaterial in a set.

Complement of a set The complement of a set A is that set of elements which together with A, constitutes the universal set $\mathcal{E}$ (q.v.). The complement of A is written A'.

Element of See Member of.

Empty set A set possessing no members, written as

$\{\}$ or $\emptyset$.

The empty set is a subset of every set.

Equal Sets Two sets, A and B, having identical members are said to be equal; e.g. if A = $\{a, b, c\}$ and B = $\{b, a, c\}$, then A = B.

Intersection of Sets (Symbol $\cap$) The set of members which is common to two or more sets;

e.g. $\{red, green, yellow\} \cap \{green, blue, yellow\}$

$= \{green, yellow\}$.

Member of, or element of (Symbol $\in$) any one of the objects in the set

e.g. $a \in \{vowels\}$

reads 'a is a member of the set of vowels'

The symbol $\notin$ reads 'is not a member of' .

Subset (Symbol $\subset$) A set which is part of the original set. This set may contain all, some, or none of the members of the original set.

Union of two sets (Symbol $\cup$) The set of all elements that are in the first set, or in the second set, or in both.

e.g. $\{cat, rat\} \cup \{rat, dog, cow\}$

$= \{cat, rat, dog, cow\}$

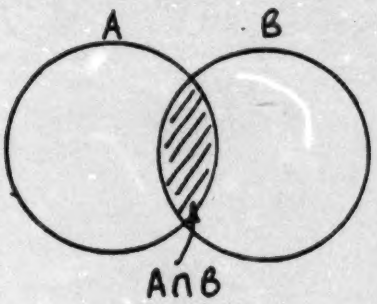
Universal set (Symbol $\mathcal{E}$ or E)

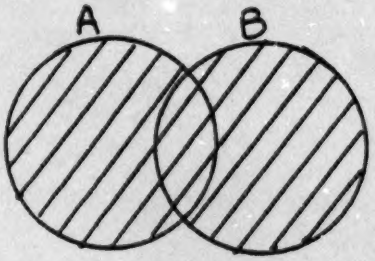
A conveniently chosen set of which all the sets under consideration are subsets.

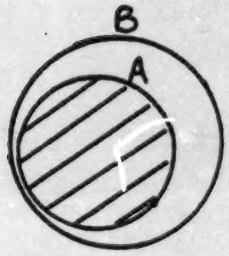
Venn diagrams

A pictorial representation of relationships between sets, often composed of circular regions.

e.g.



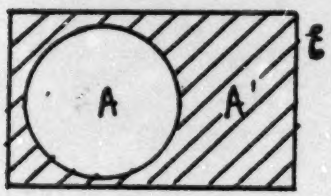




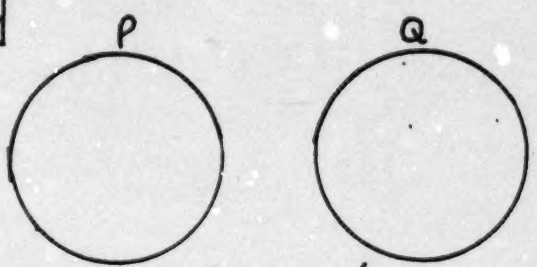
$A \subset B$

$(\sim A \cap B = A)$

The above diagrams illustrate <u>intersecting</u> sets.



$A \cup A' = \mathcal{E}$



$P \cap Q = \emptyset$.

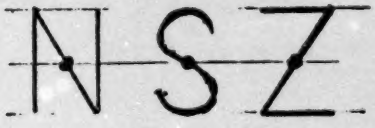
i.e P and Q are <u>disjoint</u>, or non-intersecting, sets.

APPENDIX 4 - SYMMETRY

A two-dimensional figure may possess symmetry, of reflection or of rotation, or of both

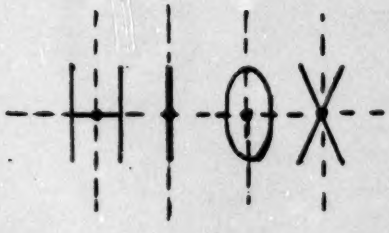
e.g.

reflection (showing lines of symmetry)



rotation (in this case through 180)

The dots show centres of rotation.



Both properties are possessed by

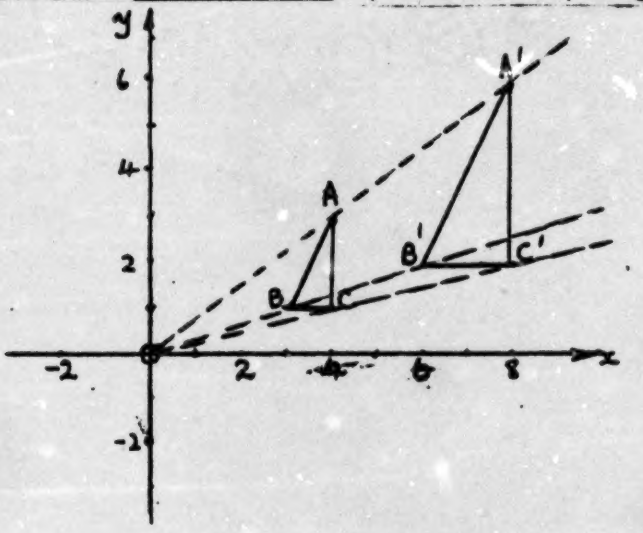
These properties can be extended to three-dimensional form.

APPENDIX 5 - TRANSFORMATIONS

A transformation is a change in the size, shape or position of a figure; e.g. reflection, rotation, translation, enlargements (and certain others).

Examples are shown below:

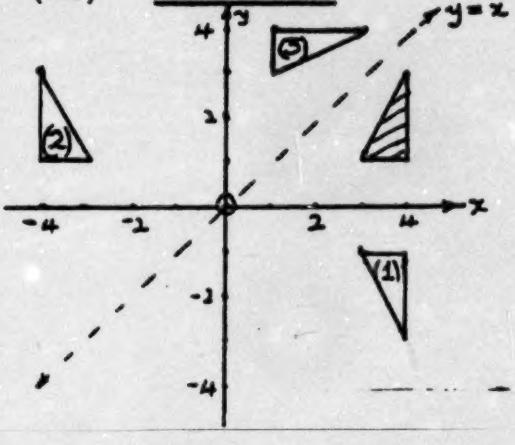
(i) enlargement (dilatation, magnification)



△A'B'C' is an enlargement of △ABC of scale factor +2, centre of enlargement (0,0).

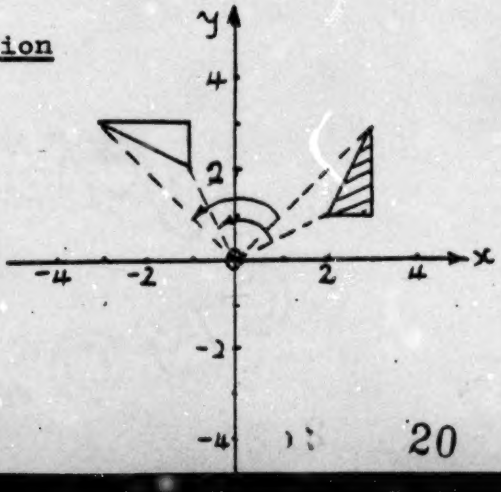
N.B. The scale factor need not be greater than 1, e.g. △ ABC can be regarded as an enlargement of △ A'B'C' scale factor $+\frac{1}{2}$; nor need it be positive. If the original and enlarged figures are on opposite sides of the centre, the scale factor is negative.

(ii) reflection



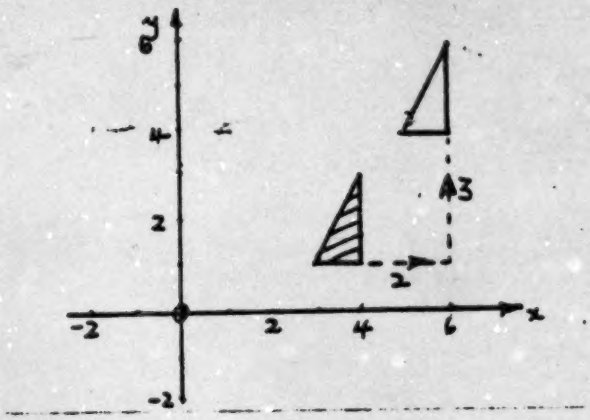
Three reflections of shaded triangle:
(1) in line y = 0 i.e. x-axis
(2) in line x = 0 i.e. y-axis
(3) in line y = x

(iii) rotation



A rotation of the shaded triangle through + 90° (i.e. counterclockwise) about (0,0), the centre of rotation.

(iv) **translation**



a translation of the shaded triangle, with vector $\begin{pmatrix} 2 \\ 3 \end{pmatrix}$

APPENDIX 6 - UNITS

The Imperial System of weights and measures previously used in Britain, is now being progressively replaced by S.I. (Système Internationale).

The basic S.I. Unit of mass is the kilogramme (kg).

1 kg = 1000 g
and 1000 kg = 1 tonne.

The basic S.I. Unit of length is the metre (m).

1 km = 1000 m
1 mm = $\frac{1}{1000}$ m

The centimetre (cm), though not an official sub-unit, is frequently used, and is $\frac{1}{100}$ m , or 10 mm.

The Unit of capacity is the litre, i.e. $\frac{1}{1000}$ m^3

A sub-unit frequently used is the millilitre (ml) which is equivalent to the cubic centimetre (cm^3).